Exploiting Complexity

The abaci Partnership

Sustaining 'Peak Precision' – Can digital devices be part of a Zero-Carbon future?

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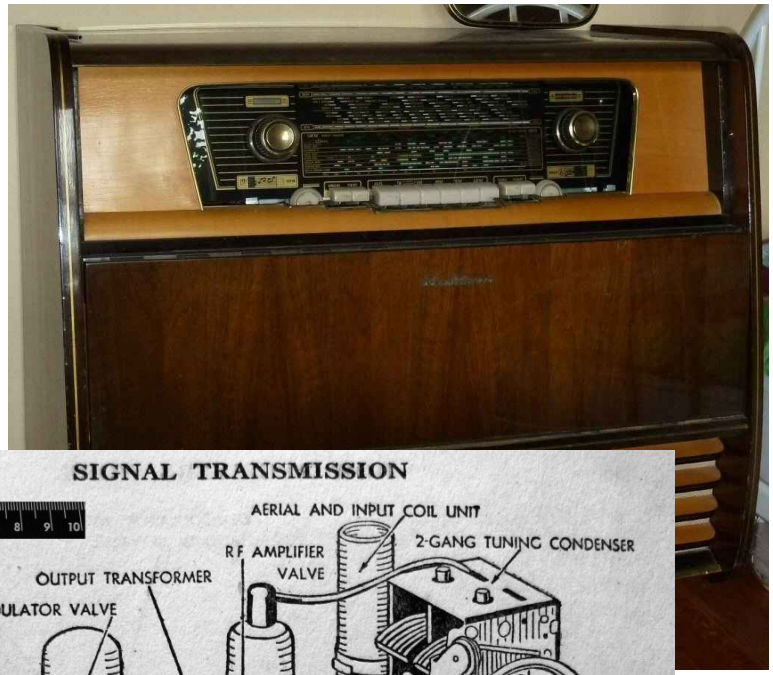
01 Peak Precision . . .

The abaci Partnership

What is the minimum viable level of 'precision' needed for sustaining a Zero-Carbon future?

And why might it matter?

01 Peak Precision . . . it might matter because of energy efficiency . . .



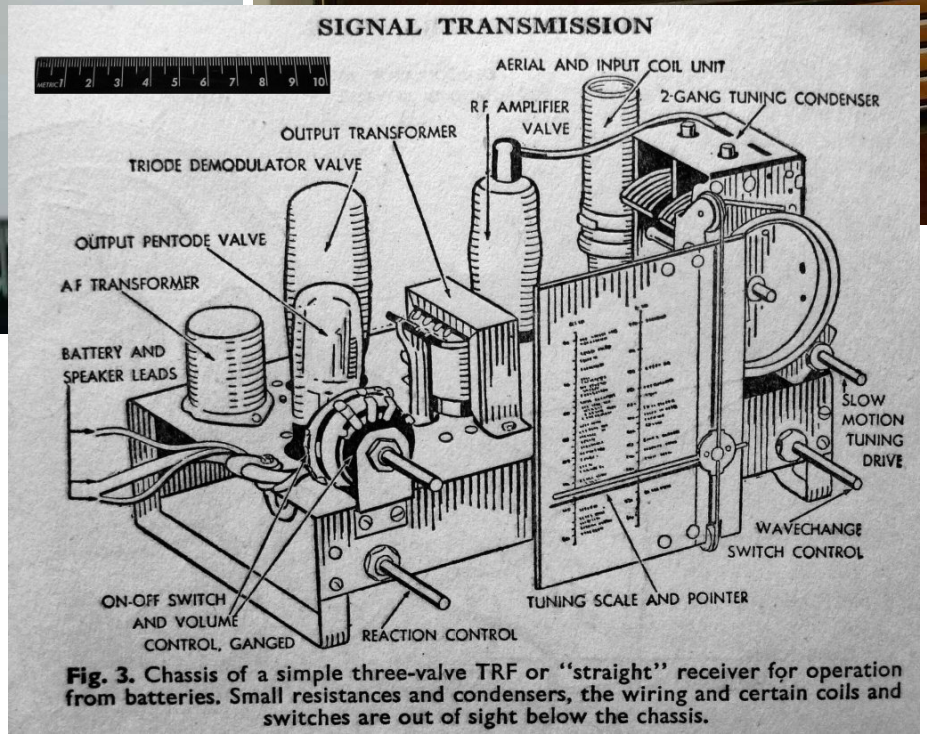


Fig. 3. Chassis of a simple three-valve TRF or "straight" receiver for operation from batteries. Small resistances and condensers, the wiring and certain coils and switches are out of sight below the chassis.

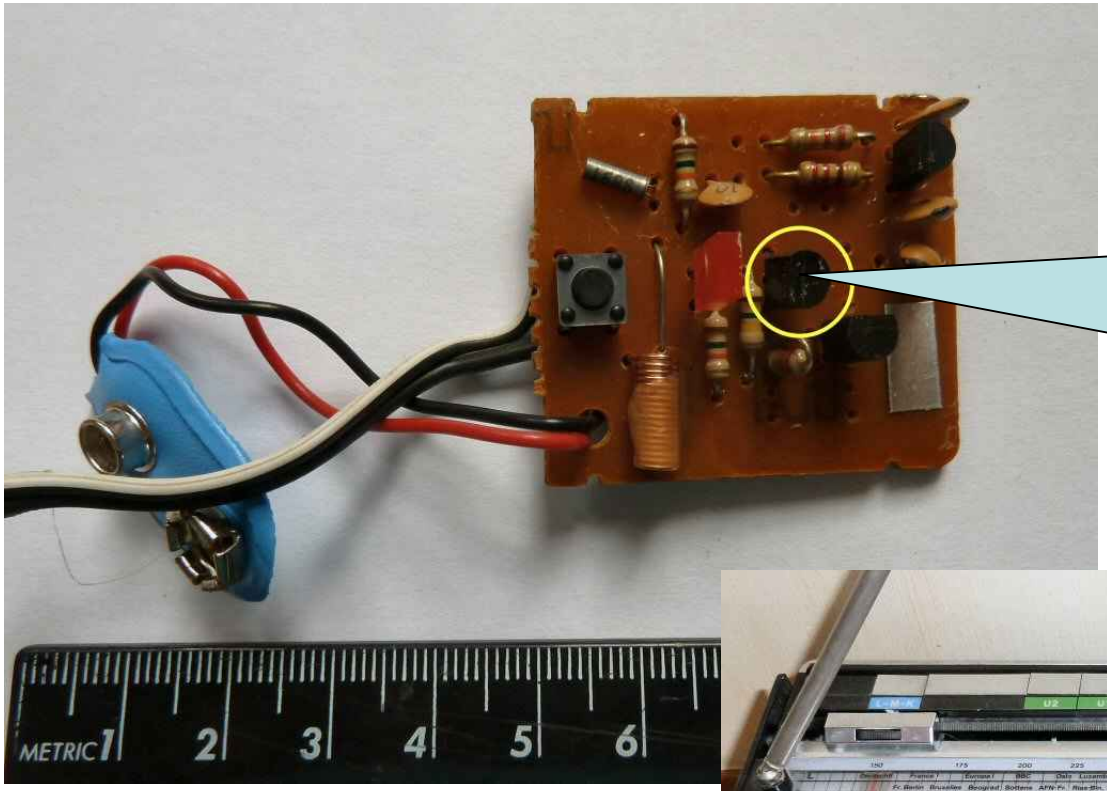
A radio valve from the

1950s

(milli-meters)

10^{-3}

01 Peak Precision . . . it might matter because of energy efficiency . . .



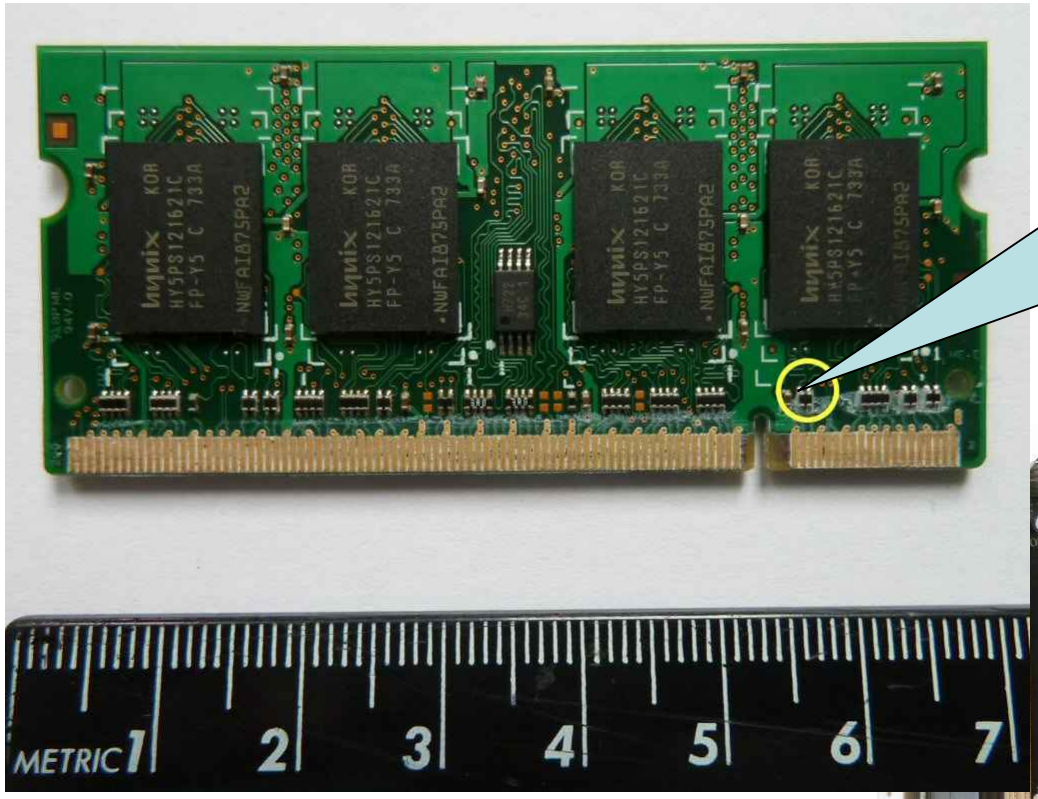
This transistor does the same as the valve, yet is a thousandth the size

1970s

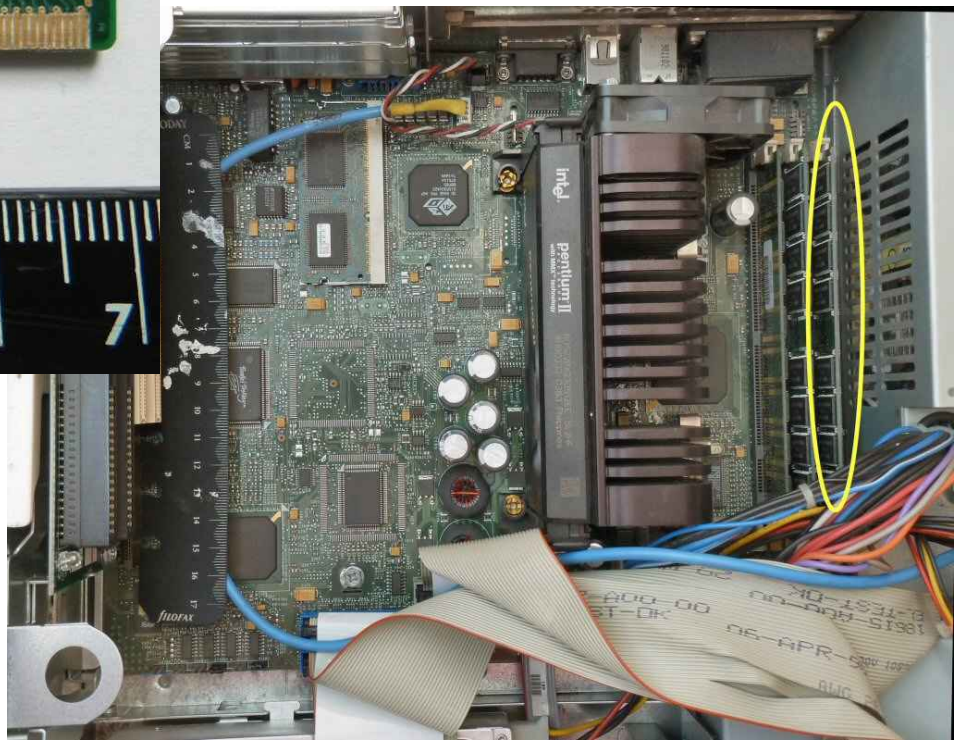
(micro-meters)

10^{-6}

01 Peak Precision . . . it might matter because of energy efficiency . . .



Does same as transistor on the previous circuit board, yet is a thousandth the size



1990s

(nano-meters)

10^{-9}

01 Peak Precision . . . it might matter because of energy efficiency . . .

In 60 years – less than a millionth the size, and 10 thousandth of the energy consumption – technology is Green, precision has to be sustained as part of a low-carbon future!

2010s

(pico-meters)

10^{-12}

02 Graphs for Peak Oil . . .

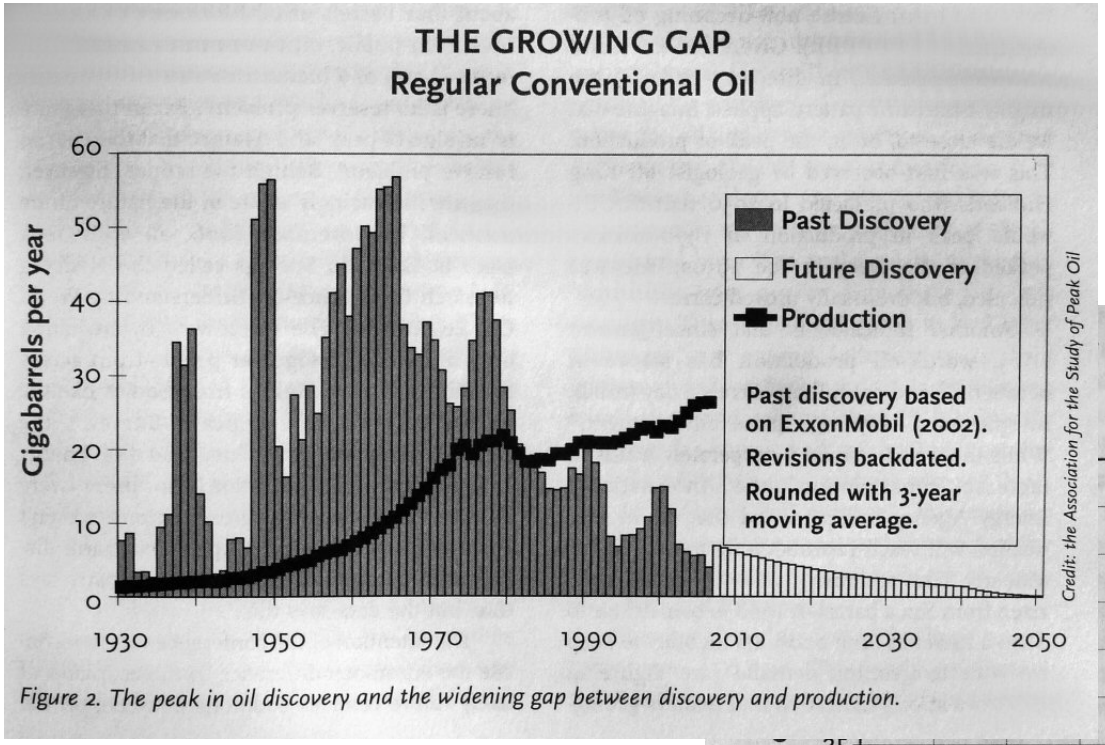
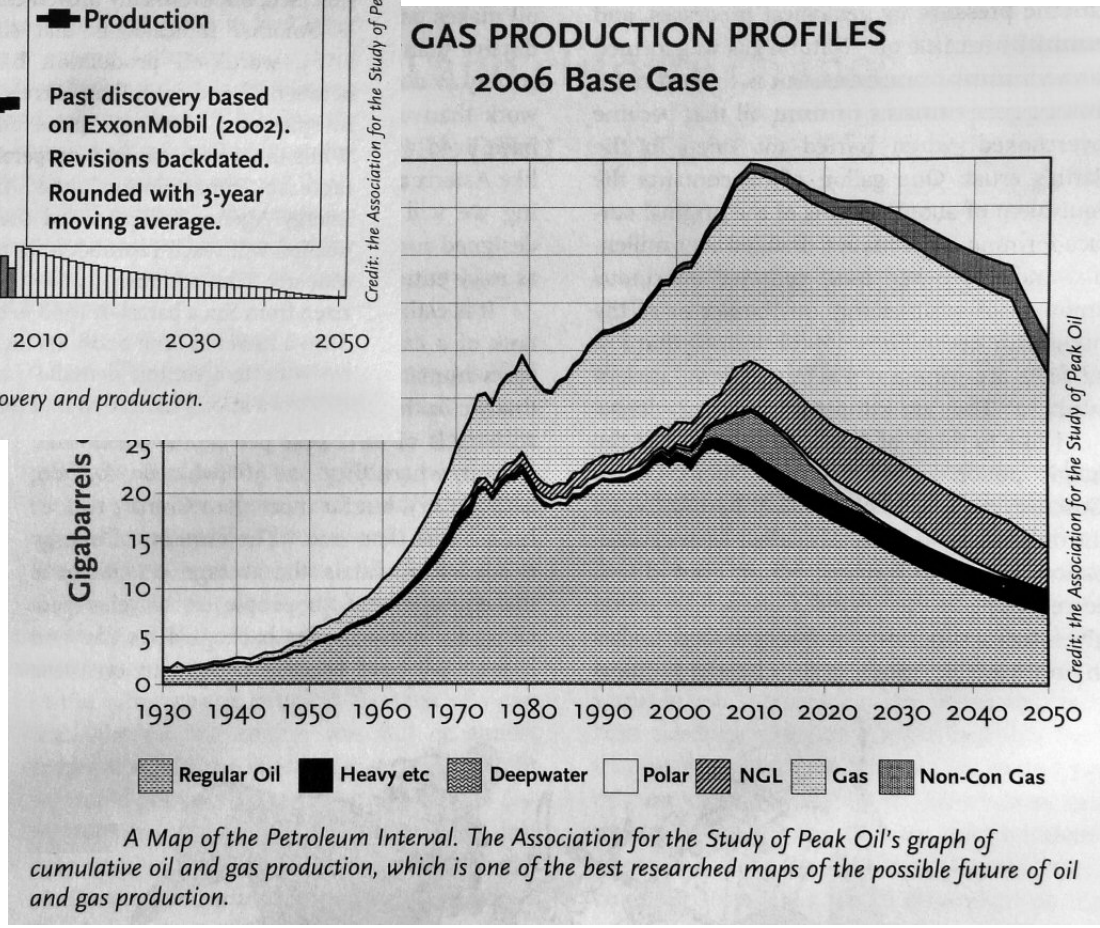
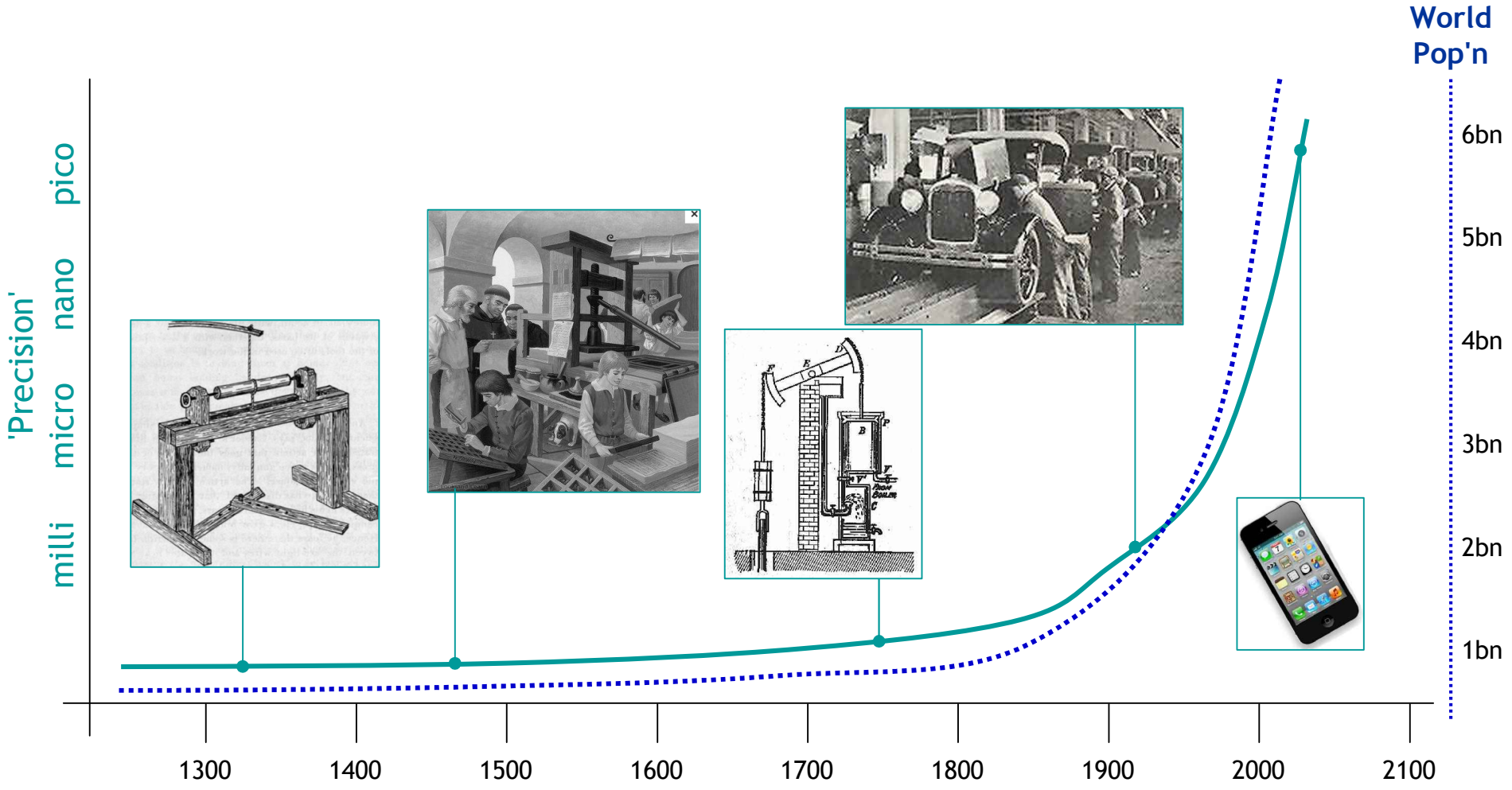


Figure 2. The peak in oil discovery and the widening gap between discovery and production.



A Map of the Petroleum Interval. The Association for the Study of Peak Oil's graph of cumulative oil and gas production, which is one of the best researched maps of the possible future of oil and gas production.

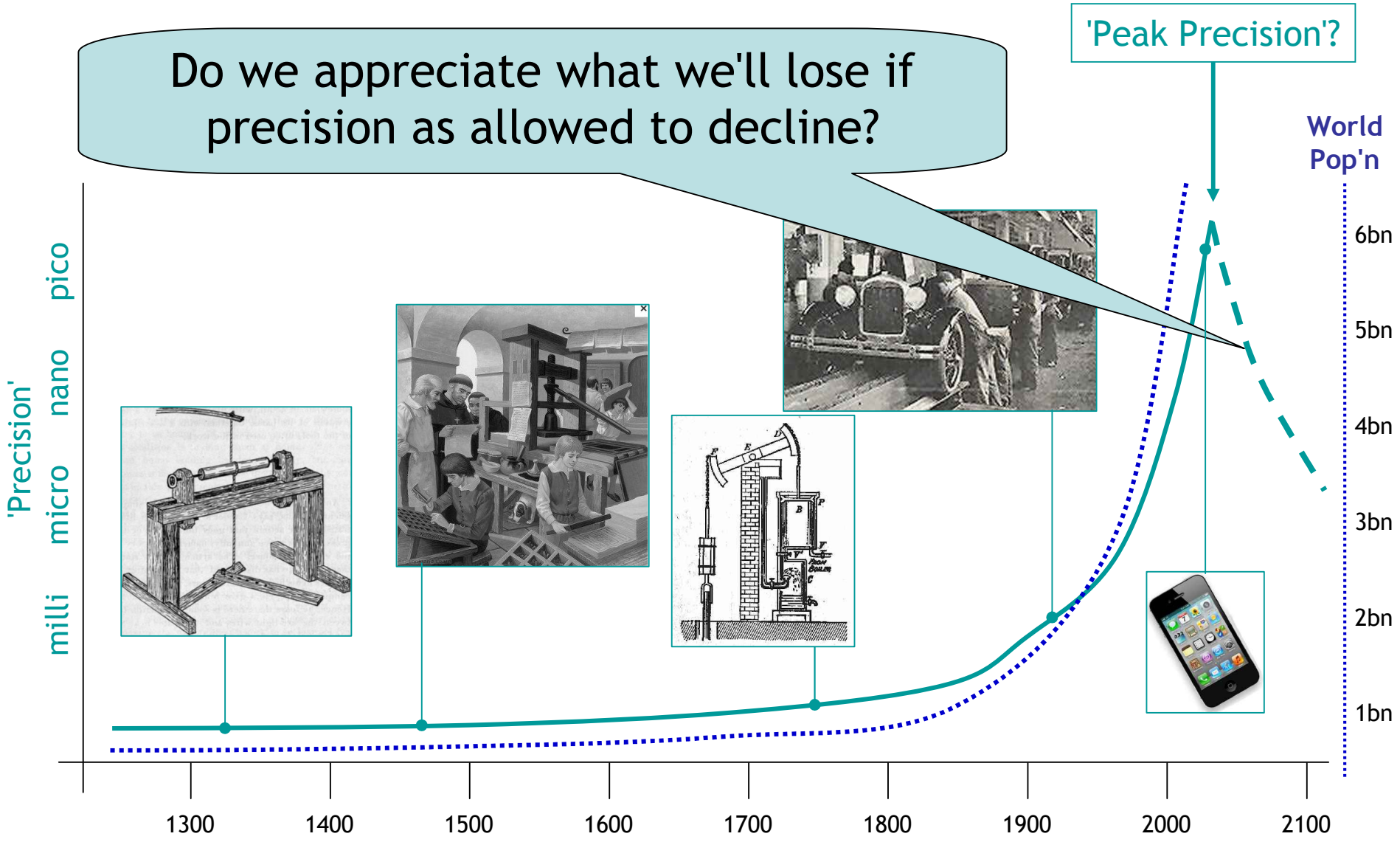
02 Graph for Peak Precision? . . .



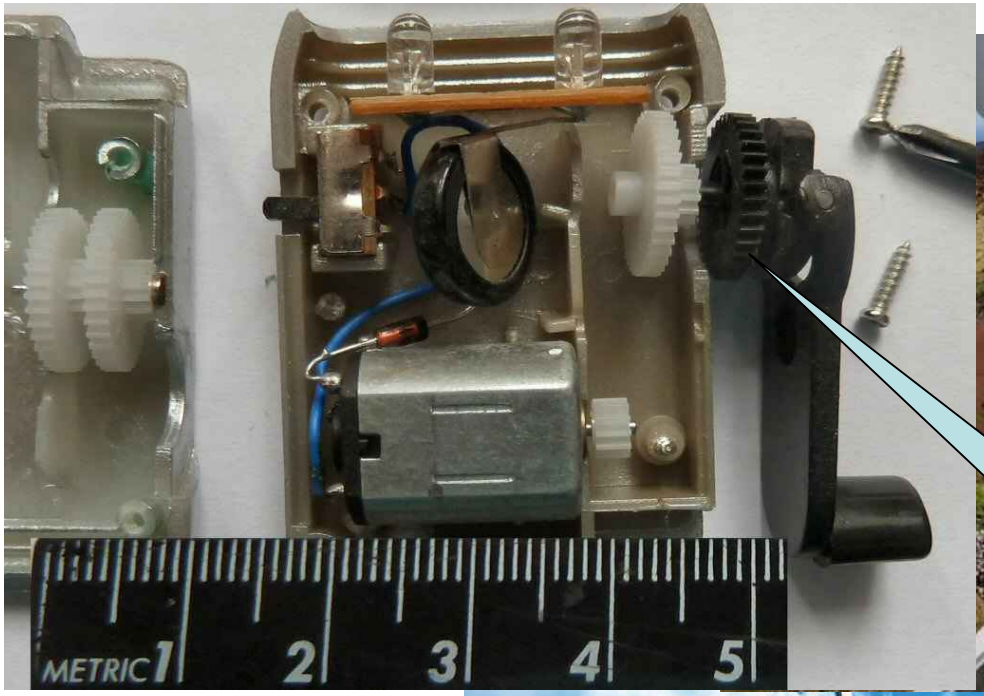
02 What made the difference?

The ability to make precise, identical, interchange-able and modular units repeatably – with machine muscle-power

03 Graph for Precision Descent? . . . what the minimum needed?

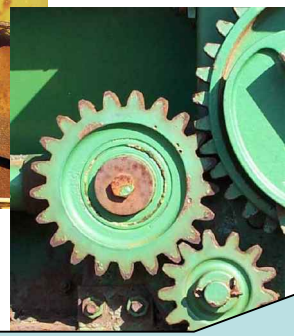


03 Sustaining Precision . . . a 'Precision Action Plan' - electricity



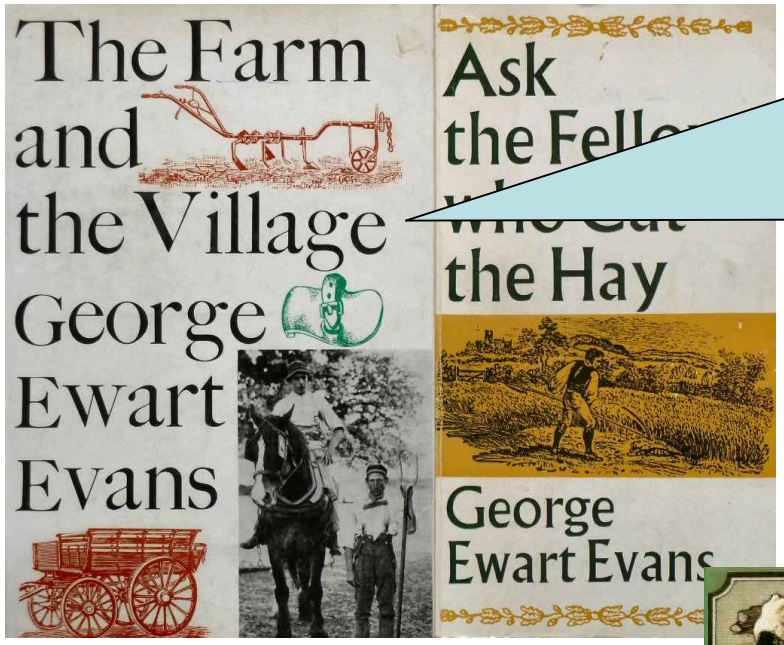
Could you make lots of these by hand?

03 Sustaining Precision . . . a 'Precision Action Plan' - bicycles

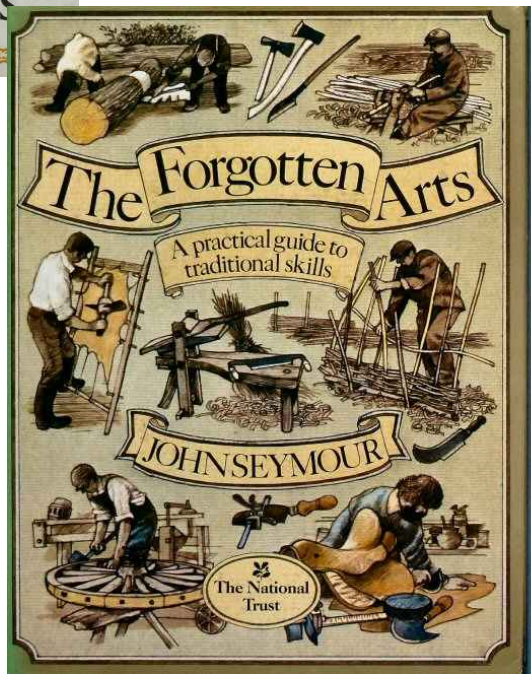


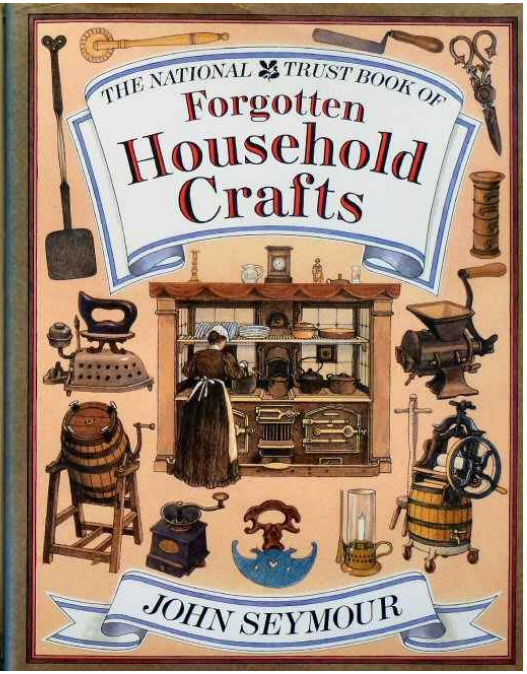
High-tech materials and engineering – light, easy to pedal, energy / effort-saving!

03 Peak Precision – the declining curve?



Or is self-sufficiency the way?
Just let digital devices go as part of purposeful 'descent'?
I think not – it would require global population to fall to below a billion … so?



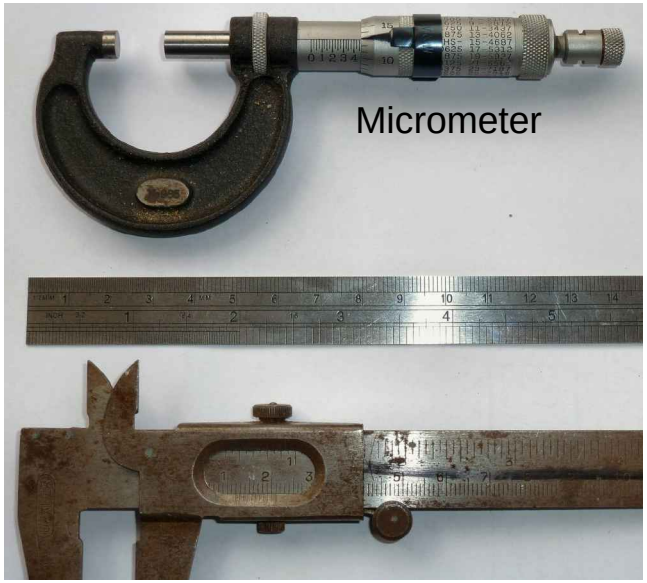


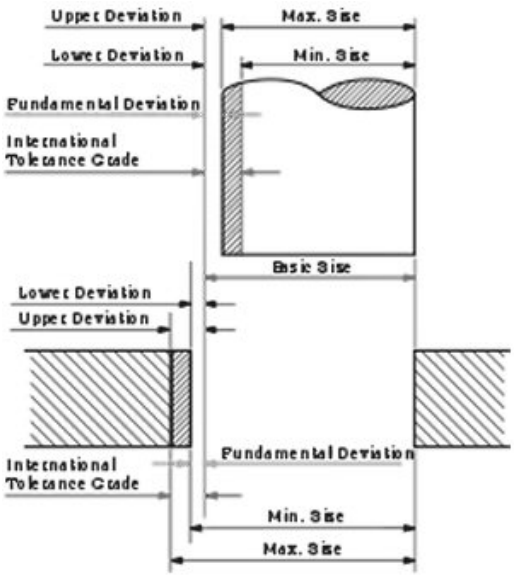
04 Sustaining Precision – what next?

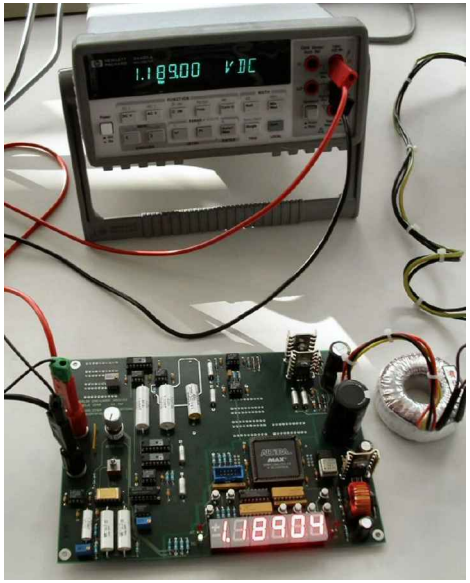
- How about working on a Precision Action Plan and trading off possible futures?
  - What's the 'precision-food-chain'?
  - What does everything else depend on – what's the 'point of no return'?
  - What has to be sustained, what's involved in sustaining it . . .
    - what are the transition issues and challenges?
    - which knowledge, materials, technologies, tools and green skills are required . . .

04 Precision – and design

- What is the minimum viable level of 'precision' needed for sustaining a Zero-Carbon future:
  - Of design and specification:
    - measurement, units, duplication, interoperability and scale.
  - Of materials and their consistency of properties:
    - standards, compatibility, coding and testing.

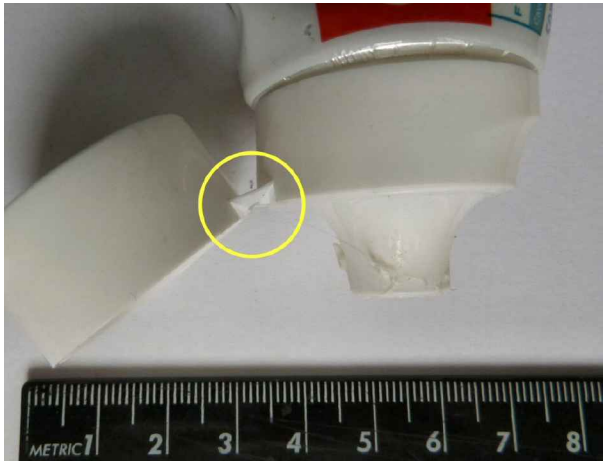






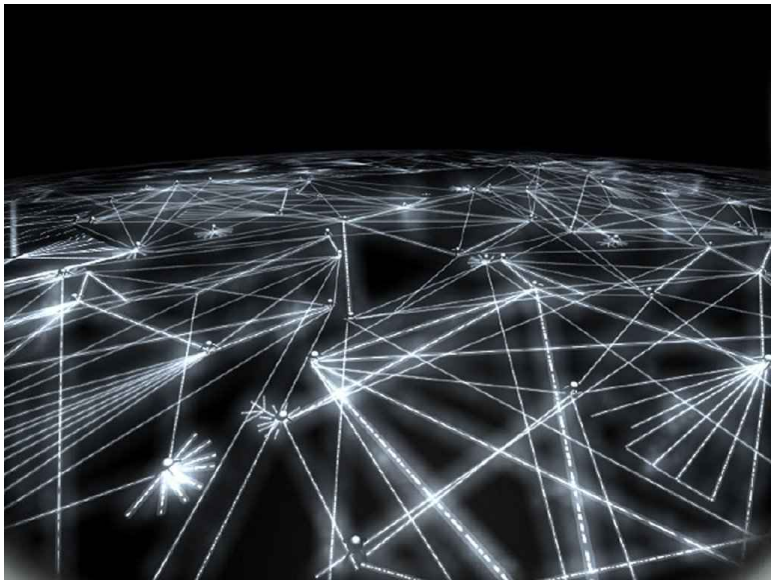
04 Precision – and 'manufacture'

- What is the minimum viable level of 'precision' needed for sustaining a Zero-Carbon future:
  - Of engineering / technical precision of manufacture:
    - miniaturisation (UV light / clean rooms / resolution).
    - heavyweight fabrication (leverage, hydraulic power / tools).
    - repeatability (machine control / 'quality').
    - modularity / interchange-ability (for maintenance).



04 Precision – and wider utility

- What is the minimum viable level of 'precision' needed for sustaining a Zero-Carbon future:
  - Of temporal and spatial precision:
    - for coordination and synchronisation (local and global).
  - Of 'run-time' energy efficiency and functional effectiveness:
    - Of sensing, 'signalling' and communication across 'smart grids':
      - control logic / handshaking;
      - displays and indicators.
    - Of 'smart buildings / towns':
      - dynamic, resource-aware devices, smart meters . . .
      - adaptive local networks . .
      - global Internet?



04 Precision is needed for? Summary

- Low energy - high-tech precision engineering, design, manufacture and production is needed for, among other things:
  - researching, developing processing and fabricating novel materials;
  - mitigating finite / limited availability of resources of all types (such as minimising waste by careful and thoughtful design for and implementation of re-use and recycling);
  - active balancing of variable supply with variable demand (from national to domestic levels);
  - active balancing of transmission opportunities / losses with storage opportunities / losses;
  - provision, maintenance and adaptation of flexible, 'intelligent' smart grids (communicating with) smart metering (controlling) resource-aware smart devices / appliances;
  - researching and developing novel generation, transmission and storage technologies;
  - improving the efficiency of heating and insulating technology
  - designing novel structures and materials for dwellings and workplaces;
  - maintaining efficient functioning of the low-carbon technologies, infrastructures and devices;
  - making modular, interchangeable, flexible and resilient hybrid devices that can be adapted to ongoing change (such as the Riversimple car on p117);
  - electrifying transport (road, rail and sea) and enabling the efficient delivery of biofuels';
  - geoengineering devices such as artificial trees;
  - informing agricultural practice, such as engineered biomass silos;
  - researching and developing novel foods;
  - researching and developing alternative ways of sequestering carbon.

04 Sustaining Precision – issues and challenges - Summary

Issues and challenges in transforming to a zero-carbon future include:

- there is a capability deficit pitfall waiting if we delay to develop the 'green skills' necessary to realise ZCB. The consequence of the potential deficit is decline down the 'Peak Precision' curve;
- new technologies and more efficient design are an essential part of the decarbonisation strategy;
- most of the technical solutions required for ZCB exist today and are tried and tested;
- the importance of ensuring technologies work together in combinations which are complimentary;
- working at 'economies of scale' which are valued by minimising energy and resource use;
- there is a transition / transformation issue which:
    - needs permissive legislative, trade and commercial and IPR frameworks in place;
    - means that, in the same way that you can't make iPhones and Facebook social networking software with the technology we used for making steam engines, you can't make smart grids and smart devices with the same mindset we used for consumer product manufacture - some fundamental transformations in ways-of-working will be required;
    - realises that investing in research, education, training and green skill development for low-carbon technologies is investing in a viable future by setting conditions for transformation;
    - indicates that commitment to the kind of care and attention to detail in ways-of-working is needed when manufacturing, maintaining and using smart devices and systems so that they can work effectively and efficiently over many years without having to be replaced;
    - is also about the ways that standards and assessment criteria are formulated (how 'value' is declared and 'measured' will not just be in monetary terms);
    - means we must have the ability to design and manufacture (repeatably and efficiently) to high-performance specifications down to nano-metre precision levels;
    - involves there being supporting social environment where peoples motivations and behaviours do not undermine the energy efficiency gains being obtained from EMP;
    - accepts that there will be 'learning by doing' as part of the transition.

Sustain Precision - if not . . .
When do the lights go out?